

## CLAIMS

We claim:

1. A speaker device comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit sonic output based on a desired sonic signal;

a first foam member having a forward face, an intermediate core section and a rear face, wherein said first foam member is acoustically transparent to sonic output;

said forward face being composed of a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to the forward face to supply the desired sonic signal;

said forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating at contacting edges approximately coincident with the forward face of the foam member;

film application means for applying the electrostatic film to the forward face of the foam member;

biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

coupling means for coupling a signal source to the speaker device for supplying the variable voltage which includes a sonic signal.

2. A device as defined in claim 1, wherein the foam member comprises a single foam composition forming the respective forward face, intermediate core section and rear face.

3. A device as defined in claim 1, wherein the foam member comprises an open cell structure.

4. A device as defined in claim 3, wherein the open cell structure extends from the forward face to the rear face, allowing air to pass between the respective faces for transmitting sonic output from the emitter film in forward and rearward directions.

5. A device as defined in claim 1, wherein the conductive properties of the foam member are characterized by gradual charge drain comparable with conductive packing foam.

6. A device as defined in claim 1, wherein a sonic signal source supplies an ultrasonic carrier wave and sideband sonic signal.

7. A device as defined in claim 6, wherein the sideband sonic signal is within an audio frequency range.

8. A device as defined in claim 6, wherein the carrier wave is within an ultrasonic frequency range of 25 KHz to 60 KHz.

9. A device as defined in claim 8, wherein the foam structure includes a closed cell composition for blocking air transmission between the respective forward and rearward faces.

10. A device as defined in claim 9, wherein the sideband sonic signal comprises an audio signal which is decoupled in surrounding air in accordance with acoustic heterodyning principles.

11. A device as defined in claim 1, wherein the electrostatic emitter film includes a conductive surface in noncontacting relationship with the foam member for enabling the film to capacitively respond with the first forward face to the variable voltage, said film being composed of a substantially nonconductive polymer composition.

12. A device as defined in claim 1, wherein the speaker device is configured in a tubular configuration with the forward face of the foam member forming an outer surface of the tubular configuration.

13. A device as defined in claim 1, wherein the biasing means includes a carrier frequency coupled to the foam member.

14. A device as defined in claim 1, wherein the biasing means comprises a negative pressure source applied through the rearward face of the foam member.

15. A device as defined in claim 1, wherein the biasing means comprises a separate voltage source from the signal source.

16. A speaker device comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit sonic output based on a desired sonic signal;

a first foam member having a forward face, an intermediate core section and a rear face, wherein said first foam member is acoustically transparent to sonic output;

said first foam member including a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to supply the desired sonic signal;

said forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating at contacting edges approximately coincident with the forward face of the foam member;

film application means for applying the electrostatic film to the forward face of the foam member;

insulating means positioned between the electrostatic emitter film and the conductive composition of the first foam member which has the conductive properties, wherein said insulating means is acoustically transparent to sonic output;

biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

coupling means for coupling a signal source to the speaker device for supplying the variable voltage which includes a sonic signal.

17. A speaker device comprising:

an electrostatic emitter film responsive to a variable voltage to emit audio output based on a desired audio signal;

→ a support member having a forward face, an intermediate core section and a rear face, wherein said support member is acoustically transparent to sonic output;

    said forward face being composed of a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to the forward face to supply the desired audio signal;

    said forward face including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating at contacting edges approximately coincident with the forward face of the support member;

    application means for applying the electrostatic film to the forward face of the support member;

    biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

    an audio source coupled to the speaker device for supplying the variable voltage.

18. A speaker device, comprising:

    an electrostatic emitter film which is responsive to an applied variable voltage to emit audio output based on a desired sonic signal;

    a first support member having a forward face, an intermediate core section and a rear face, wherein said first support member is acoustically transparent to sonic output;

    said first support member including a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to supply the audio output;

said forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating at contacting edges approximately coincident with the forward face of the support member;

film application means for applying the electrostatic film to the forward face of the support member;

insulating means positioned between the electrostatic emitter film and the conductive composition of the first support member which has the conductive properties, wherein said insulating means is acoustically transparent to sonic output;

biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

an audio signal source coupled to the speaker device for supplying the variable voltage which includes the audio signal.

19. A device as defined in claim 18, wherein the insulating means comprises the forward face and the intermediate core section includes the conductive properties.

20. A speaker device comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit sonic output based on a desired sonic signal;

a first foam member having a forward face, an intermediate core section and a rear face wherein said first foam member is acoustically transparent to sonic output;

at least said foam member being composed of a composition including conductive properties which enable application of a variable voltage to supply the desired sonic signal from the foam member to the emitter film;

said forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating approximately coincident with the forward face of the foam member;

film support means for positioning and displacing the electrostatic film forward of the foam member at a distance within range of electromotive forces developed within the foam member by the variable voltage; and

coupling means for coupling a signal source to the speaker device for supplying the variable voltage which includes a sonic signal.

21. A device as defined in claim 20, wherein the foam member comprises a single foam composition forming the respective forward face, intermediate core section and rear face.

22. A method for propagating sonic energy, comprising the steps of:

a) selecting a foam member having a forward face small cavities defined by surrounding wall structure which includes conductive properties enabling application of a variable voltage to the forward face to supply the desired sonic signal, wherein the foam member is acoustically transparent to sonic output;

b) applying to the forward face of the foam member an electrostatic emitter film which is responsive to the applied variable voltage to emit sonic output based on the desired sonic signal;

- c) biasing the film with respect to the forward face such that the film is responsive to the variable voltage of the foam member as an electrostatic emitter;
- d) supplying the variable voltage to the combination of foam member and emitter; and
- e) propagating sonic compression waves from the emitter into surrounding air.

23. A parametric speaker device comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit ultrasonic output;

a first foam member having a forward face, an intermediate core section and a rear face; at least said forward face being composed of a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to the forward face to supply the desired ultrasonic signal;

said forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating at contacting edges approximately coincident with the forward face of the foam member;

film application means for applying the electrostatic film to the forward face of the foam member;

biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

coupling means for coupling a parametric signal source to the speaker device for supplying the variable voltage which includes a ultrasonic signal which decouples in air to generate sonic output.

24. A device as defined in claim 23, wherein the ultrasonic signal source supplies an ultrasonic carrier wave mixed with a sideband audio signal.

25. A device as in claim 23 wherein the sonic signal is a sideband audio signal mixed with an ultrasonic carrier.

26. A device as defined in claim 23, wherein the foam member includes a closed cell composition for blocking air transmission between the respective forward and rearward faces.

27. A device as defined in claim 25, wherein the sideband audio signal comprises an audio signal which is decoupled in surrounding air in accordance with acoustic heterodyning principles.

28. A device as defined in claim 23, wherein the foam member comprises a single foam composition forming the respective forward face, intermediate core section and rear face.

29. A device as defined in claim 23, wherein the electrostatic emitter film includes a conductive surface in noncontacting relationship with the foam member for enabling the film to capacitively respond with the first forward face to the variable voltage, said film being composed of a substantially nonconductive polymer composition.

30. A device as defined in claim 23, wherein the biasing means comprises a separate voltage source from the ultrasonic signal source.

31. A device as defined in claim 23, wherein the electrostatic emitter film is a plastic electrostatic emitter film.

32. A parametric speaker device, comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit decoupled audio output based on an ultrasonic signal;  
a first support member having a forward face, an intermediate core section and a rear face;

said first support member including a composition having sufficient stiffness to support the electrostatic film and including conductive properties which enable application of a variable voltage to supply an ultrasonic carrier mixed with an audio sideband signal;

film application means for applying the electrostatic film to the forward face of the support member;

insulating means positioned between the electrostatic emitter film and the conductive composition of the first support member which has the conductive properties;

biasing means for biasing the film in direct contact with the contacting edges of the forward face such that the film is directly supported by the forward face; and

an ultrasonic signal source coupled to the speaker device for supplying the variable voltage which includes the audio sideband signal to be decoupled in surrounding air from the ultrasonic signal according to parametric, acoustic heterodyning principles.

33. A method for propagating sonic energy, comprising the steps of:

a) selecting a foam member having forward face small cavities defined by surrounding wall structure which includes conductive properties enabling application of a variable voltage to the forward face to supply the desired ultrasonic signal source mixed with an audio sideband signal;

b) applying to the forward face of the foam member an electrostatic emitter film which is responsive to the applied variable voltage to emit ultrasonic output;

c) biasing the film with respect to the forward face such that the film is responsive to the variable voltage of the foam member as an electrostatic emitter;

d) supplying the variable voltage to the combination of foam member and emitter; and

e) propagating ultrasonic compression waves from the emitter into surrounding air to be decoupled according to acoustic heterodyning principles.

34. A method for generating parametric audio output based on interaction of multiple ultrasonic output within air as a nonlinear medium, said method comprising the steps of:

a) generating an electronic signal comprising at least two ultrasonic signals having a difference in value which falls within an audio frequency range;

b) transferring the electronic signal to an electrostatic emitter diaphragm which couples directly with the air as part of a single stage energy conversion process;

c) converting the electronic signal at the diaphragm directly to mechanical displacement as a driver member of a parametric speaker; and

d) mechanically emitting the at least two ultrasonic signals from the diaphragm into the air as ultrasonic compression waves which interact within the air to generate the parametric audio output.

35. A method as defined in claim 34, wherein step b) comprises the more specific step of transferring the electronic signal to an electrostatic transducer.

36. A method as defined in claim 34, wherein step b) comprises the more specific step of transferring the electronic signal to an electret transducer.

37. A method as defined in claim 34, wherein step b) comprises the more specific step of transferring the electronic signal to an electro mechanical film diaphragm as the electrostatic emitter diaphragm.

38. A method as defined in claim 34, wherein step b) comprises the more specific step of transferring the electronic signal to a plastic film diaphragm as the electrostatic emitter diaphragm.

39. A speaker device comprising:

an electrostatic emitter film which is responsive to an applied variable voltage to emit audio output based on ultrasonic signal output;

a first foam member having a forward face, an intermediate core section and a rear face;

at least said foam member being composed of a composition including conductive properties which enable application of a variable voltage to supply the desired ultrasonic signal source mixed with an audio sideband signal from the foam member to the emitter film;

said forward face comprising a surface including small cavities having surrounding wall

structure defining each cavity, said surrounding wall structure terminating approximately coincident with the forward face of the foam member;

film support means for positioning and displacing the electrostatic film forward of the foam member at a distance within range of electromotive forces developed within the foam member by the variable voltage; and

coupling means for coupling an ultrasonic signal source to the speaker device for supplying the variable voltage which includes an audio sideband signal.

40. A device as defined in claim 39, further comprising:

a second foam member having a forward face, an intermediate core section and a rear face, said forward face of the second foam member (referred to as the second forward face) being positioned on an opposing side of the electrostatic emitter film from the first foam member;

said second forward face being composed of a composition including conductive properties which enable application of the variable voltage to the second foam member to supply the desired ultrasonic signal source mixed with an audio sideband signal;

said second forward face comprising a surface including small cavities having surrounding wall structure defining each cavity, said surrounding wall structure terminating approximately coincident with the forward face of the foam member;

film support means for positioning and displacing the electrostatic film forward of the second foam member at a distance within range of electromotive forces developed within the foam member by the variable voltage; and

coupling means for coupling a signal source to the respective first and second foam members for supplying the variable voltage as part of a push-pull configuration with respect to the emitter film sandwiched between the foam members.